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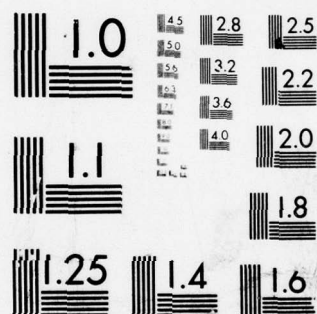
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SOLAR AND GEOPHYSICAL ASSOCIATIONS WITH THE PRINCIPAL
ENERGETIC PARTICLE EVENTS IN 1971 AND 1972

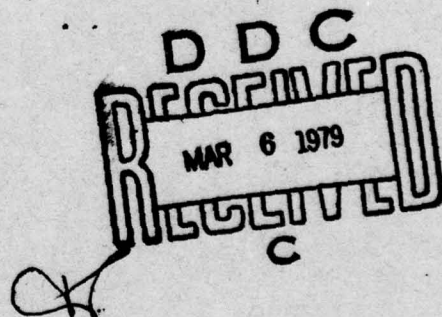
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27 relatively high energy (19-80 or >60 MEV or PCA) proton enhancements. An additional 17 high energy increases were observed, but assured solar or geomagnetic associations could not be established. Tabulations have been prepared of solar and geomagnetic circumstances prior to all events with assured flare or geomagnetic associations and/or high energy proton detection. The tabulations of this report provide solar and geomagnetic data for approximately 50% of the identified energetic particle events in 1971 and 1972. The remaining events included only those with lower particle energies and the less confident solar or geophysical associations.

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SOLAR AND GEOPHYSICAL ASSOCIATIONS WITH THE PRINCIPAL
ENERGETIC PARTICLE EVENTS IN 1971 AND 1972

- I. Introduction
- II. Evaluation of Principal Energetic Particle Events,
1971 and 1972
- III. References

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I. INTRODUCTION

This report presents results to date of a continuing effort to identify the solar and geophysical phenomena associated in time with the principal energetic particle enhancements near the earth in the post-maximum years of solar cycle 20. It is a partial extension of the studies started in the "Catalogue of Solar Particle Events, 1955-1969," (editors Z. Svestka and P. Simon). A first supplement to this catalogue with data for 1970 was published by the present authors as Report AFGL-TR-77-0222, "Survey and Comparison of Solar Activity and Energetic Particle Emission in 1970." The present study continues the survey of particle events through 1971 and 1972. It must be remembered at all times that the sensitivity of the satellite records has increased significantly over the years and has introduced a certain lack of homogeneity in that which is recognized as a particle event.

II. EVALUATION OF PRINCIPAL ENERGETIC PARTICLE EVENTS, 1971 AND 1972

Energetic particle records for 1971 and 1972 have been examined and distinctive particle events have been tabulated by Ms. M. A. Shea and Mr. Don Smart of AFGL. Lists and graphical representations of the recognized particle events were given to Miss E. R. Hedeman, Dr. H. Dodson-Prince, and Dr. O. C. Mohler for study in conjunction with the organized solar data at the McMath-Hulbert Observatory. The particle data included times of start, maximum, and duration for each event, and information relating to levels of energy detection and multiple spacecraft response. A total of 202 energetic particle events in 1971 and 1972 have been studied. The solar data used in the comparisons included not only flare-occurrence, but also the formation, growth, and disk transit of major centers of activity, and the activation of large filaments. The occurrence of geomagnetic disturbance and the passage of interplanetary sector

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boundaries also were considered in the evaluation of the probable or possible causes of observed particle enhancements.

In 1971, 83 distinctive particle events were studied and in 1972, 119 particle increases were evaluated. The conventions and symbols used in the two prior studies of particle enhancement mentioned above, have been followed in the present survey. The symbols used for flare and other associations are as follows:

- Flare association is certain
- ⊙ Flare association is probable
- Flare association is possible
- ⊖ The flare is probably a "contributor"
- Possible flare on invisible hemisphere
- △ Time-associated with a sudden commencement or an SC geomagnetic storm
- ◇ A modulation effect, including geomagnetic disturbance, and CM transit of an active region

Tables 1 and 2 and their appendices contain the principal results of the present study. The tables give information relating to all proton enhancements in 1971 and 1972, respectively, with confident flare or geomagnetic associations. The tabulations include both particle and flare data as well as remarks relating to the dynamic radio spectrum, X-ray flux, electron data (when known) and other pertinent comments. The appendices to Tables 1 and 2 give data and remarks relating to all high energy proton events (19-80 or >60 MEV or with PCA) in the years in question for which confident flare or geomagnetic associations could not be made.

For 93, 46%, of the 202 particle events, confident flare or geomagnetic associations could be established (see Tables 1 and 2). Of the remaining 109 particle enhancements without such explanations, 17 were events that included relatively high energy protons (19-80 or >60 MEV or PCA.) (See Appendices to Tables 1 and 2). In the two years studied,

there was a total of 44 such high energy events in the particle data. The "problem" high energy cases thus constituted 39% of the most energetic particle increases in the years 1971 and 1972. Do these rather numerous, energetic, "problem" enhancements perhaps stem from a certain ease of propagation from the invisible hemisphere in these simplified post-maximum years in solar cycle 20? Together, Tables 1 and 2 and their appendices account for approximately 50% of the identified energetic particle events in 1971 and 1972. The remaining events included only those with lower particle energies and the less confident solar or geophysical associations.

III. REFERENCES

- Dodson, H. W., E. R. Hedeman, Experimental Comprehensive Flare Indices for Certain Flares, 1970-1974, Report UAG-52, WDC A for Solar Terrestrial Physics, Boulder, Colorado, 1975.
- Catalogue of Solar Particle Events, 1955-1969, Z. Svestka and P. Simon, editors, Astrophysics and Space Science Library, D. Reidel; Dordrecht, Holland 1975.
- Quarterly Bulletin on Solar Activity of the International Astronomical Union, No. 173-180 (Jan. 1971-Dec. 1972), Publisher Eidgen. Sternwarte in Zurich.
- Solar Geophysical Data of Environmental Research Laboratories of U. S. Department of Commerce, NOAA No. 323-340.

TABLE 1

ALL ENERGETIC PARTICLE EVENTS IN 1971 WITH CONFIDENT FLARE OR GEOMAGNETIC ASSOCIATIONS

Particle Data			Flare Data			Comments
Time 1971	MEV	PCA	Time 1971(U.T.)	Imp. Coord.	Plage Pro- No. file	
Jan. 13 ^d 12h	P/6-19/0.004	-	⊙ Jan. 12 ^d 2352 1b	S08W36	11111 11102	5
Jan. 14 ^d 1052 ⁽¹¹³⁶⁾	E/0.5-1.1/1.4	-	● { Jan. 14 ^d 1045 sn	S08W56	11111 10102	4
			● Jan. 14 ^d 1121 1b	S09W56	11111 11213	8
Jan. 14 ^d 1130	P/19-80/0.00025	-				II(M); X=510
Jan. 15 ^d 02h	P/1-10/0.4	-	● Jan. 14 ^d 2032 sn	S24W77	11124 20101	4
Jan. 15 ^d 06h	E/0.5-1.1/1.0	-	⊙ Jan. 15 ^d 0401 sn	S22W79	11124 10000	1
						Previous proton event still in prog. X=300
Jan. 16 ^d 18h	P/1-10/0.3 >14(P8, P9)	-	● Jan. 16 ^d 0804 2n	N18E65	11128 22222	10
Jan. 24 ^d 2330	GLE(26%)	-	● Jan. 24 ^d 2308 2b	N18W49	11128 22333	13
24 ^d 2340	E/0.5-1.1/100	24 ^d 23h/	+			
24 ^d 2336	P/1.1/100	11.8db	▲ Jan. 27 ^d 0430 SC	magnetic storm begins		
Feb. 3 ^d 17h	P/1-10/0.90	-	● Feb. 3 ^d 1524 1b	S08E33	11145 11131	7
Feb. 4 ^d 2330	E/0.5-1.1/1.0	-	● Feb. 4 ^d 2259 sn	S08E16	11145 00000	0
						No low energy protons observed. IIIg, V, U(DCM, M).
Feb. 5 ^d 12h	P/1-10/2.2	-	⊙ Feb. 5 ^d 1032 sn	S10E10	11145 10101	3
Feb. 6 ^d 10h	P/1-10/3.6	-	● Feb. 5 ^d 2221 2n	S09E02	11145 12232	10
						II & IV(M); X=91.

Feb. 17 ^d 21h	P/1-10/4.28 14(P8)	-	● Feb. 17 ^d 1556 sn	S17E82	11165	20000	2	X=730.
Feb. 20 ^d 12h	P/1-10/2.4	-	● Feb. 20 ^d 0814 1n	N21W45	11162	11111	5	II(M); X=170
Mar. 21 ^d 0350 06h	E/18-139KEV/100 P/1-10/0.14	-	● Mar. 21 ^d 0330 sn	S04W78	11207	00001	1	
Apr. 2 ^d 0030 2 ^d 03h	E/0.5-1.1/2.1 P/30/0.06	1 ^d -/ 0.4db	● Apr. 1 ^d 1300 1n	S19W13	11221	11132	8	IV(M,DKM); X=56/2 1 1/2 hr.
			▲ Apr. 3 ^d 2139	SC	magnetic storm begins.			
Apr. 6 ^d 1005 6 ^d 1018 6 ^d 11h	E/45KEV/1300 E/0.5-1.1/23 P/60/1.14	6 ^d 12h/ 3.8db	● Apr. 6 ^d 0936 1b	S19W80	11221	212-1	6	Major cm bursts 37000 to 1400 MHz; X=130/4 hrs.
Apr. 20 ^d 2000 20 ^d 21h	E/0.5-1.1/1.25 P/30/.19	21 ^d 00h 0.9 db	● Apr. 20 ^d 1919 1n	S06W49	11250	21221	8	II(M,DKM), cont (DKM); X=300/4 hr.
Apr. 21 ^d 08h	E/0.5-1.1/0.83	-	● Apr. 21 ^d 0605 sn	N18W45	11256	10010	2	II(M), X=60. Protons still in prog. from prev. flare.
Apr. 22 ^d 1237 22 ^d 13h	E/0.5-1.1/1.2 P/30/.22	-	⊙ Apr. 22 ^d 0941 sn	N18W60	11256	10100	2	X=86/1 hr.
Apr. 23 ^d 07h	P/6-19/0.066	-	⊙ Apr. 22 ^d 2201 sf	N18W68	11256	20001	3	III G(DCM,M); X=300/1.5 hr.
May 4 ^d 06h	P/1-10/1.45	-	● May 3 ^d 1412 sb	N15E47	11294	30213	9	II(M); major radio bursts at all freq; X=1500.
May 6 ^d 02h	P/1-10/0.2	-	● May 5 ^d 1211 1b	N13E17	11294	21100	4	X=690/2.5 hr. Seq. mag. storm in prog. May 6 ^d 00h- 8 ^d 00h U.T.

TABLE 1 (con't)

Particle Data				Flare Data				Comments	
Time 1971	MEV	PCA		Time 1971(U.T.)	Imp.	Coord.	Plage No.	Pro- file	CFI
May 12d<0730	E/0.5-1.1/-	-		May 12d0131	2n	N13W70	11294	22211	8
May 12d03h	P/19-80/0.0022		⊙	May 12d0208	1n	N08E75	11313		II(M); X=730/6hr. Flare-Ambiguous.
May 13d1930	E/0.5-1.1/1.6	-	●	May 13d1750	1n	N10W85	11294	21231	9
May 13d20h	P/19-80/0.00025								IV(DCM), cont. (DKM); X>730/5 hr. Bright limb flare-surge, spray and loops.
May 14d1520	E/0.5-1.1/2.4	-	●	May 14d1411	1b	N04E11	11312	21232	10
May 14d17h	P/>30/.22								II & IV(M,DKM); X=860/2 hr.
Jun. 29d14h	P/1-10/0.43	-	⊙	Jun. 29d1230	sn	N18W15	11393	20132	8
									IV(DCM,M); X=220. Seq. Mag. Storm is in progress.
Jun. 29d2345	E/0.5-1.1/0.77	-	●	Jun. 29d2235	sb	N18W22	11393	10233	9
Jun. 30d03h	P/19-80/0.0024								II & IV(M,DKM); Major radio burst from 400-200 MHz.
Sep. 1d2000	GLE (16%)		■	Sep. 1d1934UT		II&IV(DCM,M, DKM), No flare	00232		7
1d2000	E/>45 KEV/-					reported but active			X(GR & F)=20/4 hr. also E>45 KEV.
1d2000	E/0.5-1.1/100	1d22h/				is at west limb.			Event also observed by Pion. 8 & 9.
1d20h	P/>60/66.5	5.2 db	+			Active reg. 11482 is on invisible hemisphere, about 2 1/2 days beyond west limb.			
			▲			Sept. 4d1645h U.T. SC magnetic storm begins.			

Sep. 15 ^d 01 ^h	P/1-10/3.39	-	⊙	Sep. 14 ^d 2338	sn	S14E59	11516	10112	7	II(M,DKM); X=220.
			+	Sep. 15 ^d 0320	1n	S12E53	11516	21112	7	II(M); X=400/4 hr.
Oct. 4 ^d <01 ^h	E/0.5-1.1/2.5	3 ^d --/	●	Oct. 3 ^d 1330	2n	N13E14	11537	32232	12	II & IV(M,DKM); X=800/6 1/2 hr.
Oct. 3 ^d 14 ^h	P/>60/.35	0.6 db	+	Oct. 5 ^d 2245	SC	magnetic storm begins.				
Nov. 23 ^d 14 ^h	P/>10/.27	-	●	Nov. 22 ^d 1511	1b	N15E72	11621	21332	11	G.B. 35000-600 MHz; II(M,DKM), IV (DCM,M), X=1900/8hr.
			●	Nov. 23 ^d 0537	1b	S18E59	11619	21322	10	G.B. 10cm; II(M), cont. (DCM, M) X=490/7 hr.
				(Flare-Ambiguous)						
Dec. 2 ^d 03 ^h	P/>10/.97	-	●	Dec. 2 ^d 0104	1b	S15W66	11619	21231	9	II & IV(M), X=580/7 hr.

TABLE I APPENDIX

MAJOR ENERGETIC PARTICLE EVENTS IN 1971 WITH UNUSUAL OR UNKNOWN SOLAR ASSOCIATIONS

Particle Data			Flare Data			Comments
Time 1971	MEV	PCA	Time 1971(U.T.)	Imp. Coord.	Plage Pro- file No.	
May 16 ^d 1218	E/18-38KEV 120					Active region 11294 is on invis- ible hemisphere, about 2-3 days beyond west limb. Mag.storm begins gradually, + later SC May 17 ^d 0630 U.T.
May 16 ^d 1300	E/0.5-1.1/4.0	16 ^d -/	May 16 ^d 1236 - IV(DCM,DKM)			
May 16 ^d 14 ^h	P/>60/.24	1.3 db	No flare reported	11294? 00031		
			May 16 ^d 22 ^h	Major magnetic storm begins, partly sequential.		
Jul.25 ^d <30 ^h	P/19-80/0.00017	-	Jul.24 ^d 1758 sn	N07W77 11425 10220		5 II(M), Cont.(M, DKM); X=130.
			Jul.24 ^d 1547 sf	N12W41 11433 00020		2 Cont.(M,DKM).
			Jul.24 ^d 1023 ln	N14W44 11433 21121		7 Cont.(DKM); X=710/2 hr.
			(Flare-Ambiguous)			
Sep.25 ^d 08 ^h	P/19-80/0.00021	-	No suitable flares			Region 11514 is on invis. hem., just beyond west limb. Mag. storm increases in intensity after 25 ^d 03 ^h U.T.
			Geomagnetic storm in prog. since Sep.24 ^d 14 ^h U.T.			
Dec.14 ^d 03 ^h	P/>60/.24	-	Dec.14 ^d 0240 - II & IV	(11656)00032	5	
			No flare reported.	(11657)		
Dec.16 ^d 23 ^h	P/>10/5.0	17 ^d -/	No suitable flares.			"delayed"
Dec.17 ^d 01 ^h	(Thule Riom.) 1.9 db		particles due to a "storage" process?			
			Dec.16 ^d 1905 ^h U.T. - SC magnetic storm begins.			

TABLE 2

ALL ENERGETIC PARTICLE EVENTS IN 1972 WITH CONFIDENT FLARE OR GEOMAGNETIC ASSOCIATIONS

Particle Data			Flare Data			Comments	
Time 1972	MEV	PCA	Time 1972 (U.T.)	Imp. Coord.	Plage NO.		Pro- file CFI
Jan. 10 ^d 23h	P/>60/.15		Jan. 10 ^d 0204 1n	S11E47	11687	01010 2	II(M); X=25/Dur. 3 hr.
			Jan. 10 ^d 2212 sn	S08E30	11687	10030 4	II(M), IV(DCM,M); X=20.
			Also geomagnetic storm Jan. 10 ^d 18h- 12 ^d 06hUT				
Jan. 20 ^d 18h	P/>30/.10	20 ^d 08 ^h & 20 ^d 21 ^h / 1.8db	Jan. 20 ^d 0321 sb	S15W02	11693	10102 4	IIIG,U(DCM,M, DKM); X=25.
			Jan. 20 ^d 0910 sn	S15W05	11693	10102 4	III G(M); X=86 Mag. storm con- tributes to parti- cle max. and long duration.
			Jan. 21 ^d 1151	SC mag.	storm begins.		
Feb. 11 ^d 08h <12 ^d 00h	E(EOSW) P/6-19/0.064		Feb. 11 ^d 0056 1f	S14E78	11734	21201 6	X=360/8 hr.
			Feb. 10 ^d 2313 1n	S17E79	11734	21111 6	II(M); X=270.
			Feb. 10 ^d 2019 sn	S19E84	11734	10130 5	IV(M,DKM); X=38
			(All could contribute to particle onset)				
Feb. 13 ^d 11h 13 ^d 13h <14 ^d	E(EOSW) P(EOSW) P/9-36/(EOS2)		Feb. 13 ^d 0827 2b	S19E47	11734	22213 10	G.B. 10cm; II(M); X=840 - Previous proton event continues in prog.
Feb. 17 ^d 15h	P/1-10/13.34		Feb. 16 ^d 1934 sf	N08E82	11748	10130 5	II(DKM), IV(M,DKM); X=95/2 hr.
			Feb. 17 ^d 0608 sn	S14E50	11743	10022 5	Cont. (M); X=54
			(Perhaps flare-ambiguous) Sequential mag. storm in prog. Feb. 17 ^d 09h-18 ^d 09h UT				

TABLE 2 (con't)

Particle Data			Flare Data			Comments
Time 1972	MEV	PCA	Time 1972(U.T.)	Imp. Coord.	Plage No. file	
Feb. 17 ^d 22 ^h 18 ^d 20 ^h	E/EOSW P/6-19/0.015	-	Feb. 17 ^d 2054	sn S23E84	11751 20231	8 II & IV(M,DKM); X=1500/>2 hr., Magnetic storm contributes to particle max. & long duration.
			Feb. 18 ^d 2339	SC mag.	storm begins.	
Feb. 22 ^d 01 ^h 22 ^d 01 ^h	E/EOSW P/19-80/0.0011	-	Feb. 22 ^d 0029	2n N03W02	11748 22333	13 Great radio bursts at cm- and m- wavelengths; II & IV(M,DKM); X=930. Note sharp second rise at 22 ^d 15 ^h on Imp.6 low energy record.
			Feb. 22 ^d 1310	1b N07W04	11748 31102	7
Mar. 6 ^d 15 ^h 5 ^d 19 ^h	E/0.5-1.1/- P/19-80/0.0018	6 ^d 01 ^h 3.3 db	(a) Mar. 5 ^d 1221	1n S07E40	11769 21122	8 Cont. (M,DKM); X=530.
			(b) Mar. 5 ^d 1135	sn S08E40	11769 20213	8 II(DCM); X=180.
			(c) Mar. 5 ^d 0807	1b S07E42	11769 213-4	≥10 Great bursts at all radio frequen. (Probably Type IV); X=5100.
			(Flare-ambiguous - all could contribute to particle onset.)			
			(d) Mar. 6 ^d 0237	sb S07E32	11769 20232	9 IV(DCM,M); X=360.
			(e) Mar. 6 ^d 1045	1b S07E26	11769 31234	13 G.B. 37000-5000MHz and 410-200MHz; II & IV(M); X=1600. IV(DCM,M).
			(f) Mar. 7 ^d 0216	1b S11E20	11769 21233	11 Particle max. is 6 ^d 21 ^h U.T.
			(These flares are "contributors" to particle max. and long duration of event.)			
			Mar. 6 ^d 2108 U.T. - SC storm begins.			

Mar. 5 ^d 22 ^h (Protons from previous event are in progress)	-	●	{ Mar. 5 ^d 2108 Mar. 5 ^d 2226	sn	S12E20	11769	10030	4 IV (M, DKM)
Apr. 10 ^d 04 ^h P/1-10/.38	-	●	Apr. 9 ^d 2318	1b	S11W73	11799	11031	6 Cont (M, DKM)
Apr. 14 ^d 20 ^h _{25^m} E/>30KEV/35	-	●	Apr. 14 ^d 1957	1b	S12W32	11813	11102	6 II (M, DKM), IV (DCM, M); X=220.
Apr. 27 ^d 20 ^h _{45^m} E/43-86KEV/50000 (Also small R & F on 1-10 MEV record)	-	●	Apr. 27 ^d 1953	sf	N10W64	11838	10000	5 An electron event on USSR Prognos satellite. No protons registered on Imp.5 at 1-10MEV
May 1 ^d 07 ^h _{30^m} E/>30KEV/15	-	●	May 1 ^d 0658	sn	S06E68	11848	00002	1 No unique new proton events. Geomagnetic storm in prog. Apr. 27 ^d 15 ^h 30 ^d 03 ^h U.T.
May 12 ^d 20 ^h E/>30KEV/29	-	●	May 12 ^d 1928	sb	N21W48	11857	10132	2 IIIg, V, U (DCM, M) No discernible low energy (1-10MEV) protons.
May 15 ^d 04 ^h P/1-10/3.2	-	●	May 15 ^d 0221	1n	S04E43	11876	21100	7 IV (M, DKM); X=60. No discernible low energy protons.
May 15 ^d 07 ^h _{50^m} E/>30KEV/40	-	●	May 15 ^d 0737	sn	S07W04	11870	101-1	4 IIIg, U, IIb (M); X=180.
08 ^h P/1-10/96.8	-	● + ▲	May 15 ^d 1849	Major SC storm begins.				≥3 X=40
May 15 ^d 20 ^h _{14^m} E/>30KEV/500	-	●	May 15 ^d 1944	sb	S05E33	11876	20000	2 Storm onset produces "spike" at 15 ^d 18 ^h on 1-10MEV record and contributed to duration of particle event. CM radio bursts only; X=310. Previous particle event continues in prog.

TABLE 2 (con't)

Particle Data			Flare Data			Comments
Time 1972	MEV	PCA	Time 1972(U.T.)	Imp. Coord.	Plage No.	
May 16 ^d 03 ^h 31 ^m	E/>30KEV/300	-	May 16 ^d 0307 1b	S06W15	11870 21232	10 IV(nCM,M); X=440/1 hr.
16 ^d 05 ^h 10 ^m	E/>30KEV/-		May 16 ^d 0403 1b	S06E29	11876 11000	2 IIb(DCM), Is(M); X=130.
16 ^d 12 ^h	P/1-10/10.7					
May 17 ^d 05 ^h 30 ^m	E/>30KEV/115		May 17 ^d 0510 sn	S06W31	11870 00102	3 IIIG,V(DCM,M,DKM); X=30. Contributes to max. of low energy event already in progress.
(P/1-10/ in prog.)						
May 28 ^d 14 ^h 30 ^m	E/>30KEV/480	28 ^d 18 ^h 2.6db	May 28 ^d 1305 2b	N09E30	11895 32333	14 G.B.at all freq.;II (M,DKM) & IV(DCM,M, DKM);X>5100/8 hr.
14 ^h 52 ^m	E/0.5-0.8/12					
16 ^h	P/>60/1.2		May 30 ^d 1421 U.T.	SC storm begins.		Mag.storm is weak and brief.
May 29 ^d 10 ^h 32 ^m	E/>30KEV/2900	PCA in Prog.	May 29 ^d 1015 1b	N08E16	11895 21222	9 Cont(M,DKM); X=490/2 hr.
(Protons from previous event in prog.)			A "contributor" to proton max. of previous event.			
Jun. 3 ^d 15 ^h 23 ^m	E/>30KEV/70	-	Jun. 3 ^d 1402 1n	N10W53	11895 21232	10 G.B. 37000-4995MHz, also at M-λ; II(M) & IV(M,DKM). X>130/1hr.
15 ^h 30 ^m	P/>30MEV/- (Prognoz)		Jun. 4 ^d 0558 sf	N11W64	11895 00201	3 IN(DCM) in prog. Seq.sector boundary passage (+/-) occurs between Jun.3-4, with very weak geomagnetic disturbance.
			Also "zone" of bright plages at center of disk.			

Jun. 5d20h 30m	E / > 30KEV / 360	-	● Jun. 5d2008 sf S05E02 11911 00000	0	III(M, DKM)
Jun. 8d13h 40m	E / > 30KEV / 220	8d15h 0.6 db	<div style="display: inline-block; vertical-align: middle;"> { Jun. 8d1317 } { 1330 } { Jun. 8d1319 sf S06W30 11911 } { 00011 } </div>	2	Is the strong particle event related to the faint sub-flare on the disk, or to activity in reg. 11895 behind the west limb?
8d17h	P / > 60 / 0.35	☐	Active region 11895 on invis. hem. 2 days beyond west limb.		
Jun. 8d17h 45m	E / > 30KEV / 80	-	☉ Jun. 8d1552 sn S19W44 11911 10000	1	I(DCM). No new proton event. PCA is in prog.
17h45m (Prognoz)	P / > 30 / -				
Jun. 8d23h 35m	E / > 30KEV / 130	-	● Jun. 8d2306 sf N06W03 11916 00000	0	Protons and PCA in prog.
Jun. 12d02h 20m	E / > 30KEV / 17	-	● Jun. 12d0153 sf S07N76 11911 10002	3	IIIg, V(DCM, M); X=35. No low energy protons detectable.
Jun. 12d20h 14d16h } 12d21h } 14d12h } 13d22h	E / > 30KEV / 80 E / 0.5-1.1 / 0.8 E / 0.5-1.1 / 1.0 P / 19-80 / 0.0010	-	● Jun. 12d1318 lb S11E53 11926 31132	10	II(M, DKM), IV(DKM); X > 1900 / 4 hr. Is late particle onset due to "storage", or possibly start of a "particle stream" related to region?
Jun. 15d11h	P / 1-10 / 14.0	-	● Jun. 15d0928 ln S11E10 11926 21212	8	II(M); X=130.

TABLE 2 (con't)

Particle Data			Flare Data			Comments
Time 1972	MEV	PCA	Time 1972(U.T.)	Imp. Coord.	Plage No. file	
Jun. 15 ^d 16 ^h 20 ^m	E/>30KEV/-	16 ^d 03h/ 2.2db	Jun. 15 ^d 1247	ln S12W02	11922 21131	IV(M,DKM); X=620/ 3hr. This flare event and the pre- ceding one form a "pair." The later event is related to an active fila- ment located be- tween regions 11922 and 11926. The pair of flares produce 2 SC's when a magnetic storm begins later on June 17.
16 ^d 02 ^h	E/0.8-1.1/3.5		(A "spotless" flare)	11926		
16 ^d 05 ^h	P/>30/0.28					
			▲ Jun. 17 ^d 0630 (1311)	SC storm begins.		
Jun. 20 ^d 22 ^h	P/1-10/-	-	● Jun. 20 ^d 1916	sb N04E85	11933 10132	7 II(M), IV(DKM); X>360.
Jul. 13 ^d 16 ^h 28 ^m	E/>30KEV/30	-	{ Jul. 13 ^d 1604 sn Jul. 14 ^d 0006 sn	N12W66	11957 10000	1 III; X=50/1 hr.
14 ^d 00 ^h 29 ^m	E/>30KEV/170					
13 ^d 21 ^h	P/1-10/0.34			N12W69	11957 10100	2 III(DCM,M,DKM); X=25/2 hr.
Jul. 22 ^d 06 ^h 57 ^m	E/>30KEV/270	-	● Jul. 22 ^d 0549	sn S08W50	11958 00010	1 El. and Pr. are reported by USSR Prognoz satellite. II(M), III G,V(M).
22 ^d 06 ^h	P/>30MEV/- (Prognoz)					
Jul. 27 ^d 05 ^h 57 ^m	E/>30KEV/485	-	● Jul. 27 ^d 0520	sn S14E41	11970 00000	0
			● + Jul. 27 ^d 0632	sn S05E19	11968 10011	3 II(M); X=30.

Jul. 28 ^d 13 ^h 35 ^m 14 ^h	E/>30KEV/430 P/19-80/0.027	-	● + ◆	Jul. 28 ^d 1320 sn	S20E49 11974 10102	4 X=180
				(Active region 11926 is coming around the east limb.)		
Aug. 1 ^d 13 ^h 30 ^m 1d20 ^h	E/>30KEV/- P/1-10/10.1	-	● + ⊙	{ Aug. 1 ^d 1133 sn N13E46 11976 } Aug. 1 ^d 1148 sb S20W04 11974 } Aug. 1 ^d 0841 1n N13E48 11976 21102	10102 10102	4 6 X>326.
Aug. 2 ^d 08 ^h 00 ^m	E/>30KEV/-	3 ^d 06 ^h 2 db	●	Aug. 2 ^d 0316 1b N13E35 11976 31322	11 G.B. 10cm/2600; Is + cont/DCM,M; X=1790/14 hr.	
{ 2 ^d 05 ^h 15 ^m 3 ^d 02 ^h 30 ^m }	E/0.5-1.1/3.1 E/0.5-1.1/9.0		+			
{ 2 ^d 08 ^h 3 ^d 03 ^h }	P/19-80/0.045 P/19-80/-		●	Aug. 2 ^d 1958 2b N13E27 11976 22334	14 G.B. 10 cm/9735; IV (DCM,M,DKM); X=1470/16 hr.	
Aug. 3 ^d 15 ^h 18 ^m	E/>30KEV/100	-	●	Aug. 3 ^d 1502 1n S12W57 11970 11102	5 X=76.	
(Protons and PCA from previous event in prog.)						
Aug. 4 ^d 13 ^h 00 ^m	GLE					
Aug. 4 ^d 08 ^h (Electron record saturated since 4 ^d 02 ^h U.T.)	P/>60/-	4 ^d 04 ^h >20 db	●	Aug. 4 ^d 0620 3b N14E08 11976 33335	17 G.B. 10cm/7600; IV(M); X>4560/ 15 hr.	
Aug. 7 ^d 15 ^h 30 ^m	GLE					
7 ^d <17 ^h 7 ^d 15 ^h 40 ^m 7 ^d 16 ^h	E/>30KEV/4700 E/0.5-1.1/100 P/>60/70.5	7 ^d 18 ^h 14db	● + ▲	Aug. 7 ^d 1443 3b N14W36 11976 33333	15 G.B. 10cm/4500; II (M,DKM) IV (DCM,M,DKM); X>4560/12 hr.	
				Severe geomag. storm begins, two SC's at 8 ^d 2354 UT and 9 ^d 0036 UT.		
				Storm continues through Aug. 11.		

TABLE 2 (con't)

Particle Data			Flare Data			Comments
Time 1972	MEV	PCA	Time 1972(U.T.)	Imp. Coord.	Pro- file No.	
Aug. 10 ^d 08 ^h 27 ^m	E/>30KEV/-	-	Aug. 10 ^d 0810 1n	N16W48	11987 01000	1 No electron event on 0.5-1.1 Mev.
(protons from previous event continue in prog.)						
Aug. 19 ^d 14 ^h 55 ^m	E/>30KEV/60	-	Aug. 19 ^d 1431 1b	N17W67	11985 21101	5 IIIg (M,DKM); X=326. No proton event on 1-10 MEV records.
Aug. 26 ^d 20 ^h	P/1-10/19.05	-	Aug. 26 ^d 0348 - II(M) 0350 - IV(M) + No known flare.	12011?	10132	7 Large, bright and active region 12011 is on invis- ible disk, just beyond east limb.
Moderate geomagnetic storm (SC 25 ^d 2258 U.T.) is in progress and increases in intensity.						
Sep. 4 ^d 01 ^h	P/0.2-0.56/9.9	-	Sep. 4 ^d 0020 1f	S11W50	12005 01001	2
Sep. 6 ^d 13 ^h	P/1-10/0.28	-	Sep. 6 ^d 0407 1b	S07W87	12005 21132	9 II & IV(M).
Sep. 6 ^d 22 ^h 03 ^m	E/~30KEV/57	-	Sep. 6 ^d 2149 sn	S08W29	12016 10133	8 II & IV(DCM,M).
6 ^d 22 ^h 02 ^m	E/0.5-1.1/1.4					
6 ^d 23 ^h	P/19-80/0.100					
Sep. 10 ^d 16 ^h	P/1-10/8.17	-	Sep. 10 ^d 1237 sf	N11W62	12023 10030	4 IV(M,DKM).
+ 0						
			Sep. 10 ^d 1745 - II(M,DKM)	12011?	10010	2 Small bright spike reported at N.W. limb at 1730 U.T. (McM-H. notes).

Sep. 26 ^d 06 ^h	P/1-10/0.17	-	⊙ + ⊕	Sep. 26 ^d 0147 1n	S06E06 12044 21100	4	X=204/1.5 hr. Region 12044 is a return of active region 12005.
Oct. 8 ^d 03 ^h	P/1-10/0.76	-	●	Oct. 7 ^d 2225 2n	N19W25 12057 02031	6	IV(M,DKM); X=10/8 hr.
Oct. 15 ^d 12 ^h 45 ^m	E/100-200KEV/ 815	-	●	Oct. 15 ^d 1016 1n	S11E87 12086 01000	1	
Oct. 25 ^d 14 ^h	P/1-10/-	-	⊙ + ⊕	{ Oct. 25 ^d 1004 1b Oct. 25 ^d 1135 1n	S13E59 12094 21002 S08E55 12094 21224	5 11	IIlg(M); X=2770. IIlg & cont(M, DKM); X=197. Is, C in prog; X=3100. A con- tributor to particle max. at 26 ^d 10h U.T.
Oct. 29 ^d 07 ^h 45 ^m	P/0.8-2.1/2.7	-	●	Oct. 29 ^d 0257 1n	S13E08 12094 11102	5	IIlg, U(DCM, M); X=159.
Oct. 29 ^d 19 ^h 00 ^m	E/30KEV/800 30 ^d 14 ^h / 2 db	-	●	Oct. 29 ^d 1613 sb	S15W02 12094 20230	7?	IV(M,DKM) called I c and cont. by others. Major X>326/15hr. The moderately severe SC storm seems related to additional burst of particles on 31st, and to par- ticle max. at 31 ^d 16h U.T.
29 ^d 20 ^h	P/19-80/0.0025	-	+				
			▲	Oct. 31 ^d 1654	- SC storm begins.		
Oct. 30 ^d 02 ^h 30 ^d 5 ^h	E/30KEV/280 E/0.5-1.1/-	-	●	Oct. 30 ^d 0142 sn	S09W09 12094 00100	1	III G,V(M,DKM). Protons in prog.

TABLE 2 (con't)

Particle Data				Flare Data				Comments
Time 1972	MEV	PCA		Time 1972(U.T)	Imp. Coord.	Plage No.	Pro- file	
Oct. 30 ^d 08 ^h 40 ^m	E/>30KEV/300	30 ^d 14 ^h 2 db	●	Oct. 30 ^d 0722	1n S10W04	12094	111-2	≥5 X=489.
30 ^d 12 ^h	P/>30/231							Protons in prog. from major earlier event of Oct. 29th. New injections of particles after ~05h and 09h UT.
Oct. 30 ^d 17 ^h 25 ^m	E/>30KEV/>600	PCA in prog.	●	Oct. 30 ^d 1646	1b S10W10	12094	21101	5 III S(M,DKM); X=212.
Oct. 31 ^d 06 ^h 10 ^m	E/>30KEV/150	PCA in prog.	●	Oct. 31 ^d 0417	1b S14W15	12094	21100	4 III G(DCM,M); X=1960 Also new injection of low energy par- ticles after ~31d09h U.T.
Nov. 24 ^d 17 ^h	P/1-10/0.79	-	●	Nov. 24 ^d 1234	sn S07W33	12115	20132	8 IV(M); X=159/7 hr.
Nov. 25 ^d 09 ^h 25 ^d 09 ^h	E/>30KEV/1000 P/19-80/.00066	-	●	Nov. 25 ^d 0817	1b S06W44	12115	21233	11 II & IV(M); X=490/7 hr.
Nov. 28 ^d 04 ^h 40 ^m 28 ^d 08 ^h	E/>30KEV/100 P/19-80/0.001	-	●	Nov. 28 ^d 0358	1n S08W81	12115	11130	6 II & IV(M); X=114/7 hr.
Dec. 16 ^d 04 ^h 00 ^m 16 ^d 06 ^h	E/>30KEV/100 P/>10/0.76	-	●	Dec. 16 ^d 0341	1b N12W57	12136	21232	10 II(M), IV(DCM,M); X=1010/6 hr. Moderate geomag. storm in progress since 15d08h U.T.

TABLE 2 APPENDIX

OTHER MAJOR PARTICLE EVENTS - 1972

Particle Data			Flare Data			Comments
Time 1972	MEV	PCA	Time 1972(U.T.)	Imp. Coord.	Plage Pro- No. file	
Jan. 3 ^d 11h	P/>>30/.13	-	Jan. 3 ^d 0728	sn S06W46	11666 00001	1
			{ or □? Jan. 3 ^d 0402 - II(M)			1
					11661? 00010 11657?	Region 11661 is at SW limb. Active region 11657 is on invisible hemisphere 3 days beyond west limb.
Mar. 11 ^d 01h 30 ^m	E/0.5-1.1/-	-	(Problem) Mar. 11 ^d 0020-0730 UT: long-enduring X-ray event with very gradual rise and fall, peak flux = 73 at 0055UT. Several sf flares at S11W32 during this interval, in region 11769. (I=1 & 2)			No geomag. dis- turbance is in prog.
11 ^d 01h	P/19-80/.0002	-	(Problem) Numerous sub-flares prior to particle onset, mostly in region 11769 (I = 3 & 4). Active region 11776 is transiting the central portion of the solar disk between Mar. 11-17.			
Mar. 11 ^d 12h	P/19-80/.0003	-	(Problem) No suitable flares Several active regions are on invis. hem., about 1 to 3 days beyond west limb. A new + sector is introduced on Mar. 27 & 28, into what had been a predominantly-sector for the pre- vious 5 solar rotations.			Gradual geomag. storm occurs dur- ing particle event (Mar. 29d-31d).
Mar. 28 ^d 07h 28 ^d 08h	E/EOSW P/19-80/.0038	-				

TABLE 2 APPENDIX (con't)

Particle Data			Flare Data			Comments
Time	MEV	PCA	Time	Imp. Coord.	Plane Pro- file No.	
1972			1972(U.T.)			CFI
Apr. 17 ^d 21 ^h	E-/30KEV/24	18 ^d -/	(Problem)			
17 ^d 22 ^h 17 ^m	E/0.5-1.1/4.4	4.5 db	(a) Apr. 17 ^d 1654 sn	S10E52 11827	10000	1 IIIb(M,DKM); X=small burst.
17 ^d 23 ^h	P/19-80/0.14		(b) Apr. 17 ^d 1843 sf	S19W70 11813	00100	1 Long GR & F at 10 cm and X-rays (1840 > 2500 UT).
			+ eruptive prom. at SW limb (S35W90) beginning ~1800UT. Prom. gone at 1900 UT.			
			(c) Apr. 17 ^d 2108 sf	S13E50 11827	00000	0 X=small burst
			Apr. 17 ^d 23 ^h UT - Gradual sequential geomag. storm begins.			Possible "contribu- tors" to particle onset and long duration.
			Region 11827 very flare-active on Apr. 17 & 18; transits central area of disk Apr. 17-24			
			Apr. 18 ^d 0055 1b	S12E47 11827	21121	7 Is + cont(M); X=270. A "contribu- tor" to particle Max.
			Apr. 20 ^d 2050 - SC storm begins.			Active region 11827 is on disk, approach- ing west limb, but is not "flaring."
Apr. 26 ^d 09 ^h	E/0.5-1.1/0.86	-	(Problem) No suitable flares			
26 ^d 12 ^h	P/19-80/.00095		New region 11838 (N10, CMP Apr. 23) grows rapidly on disk on and after Apr. 26. Sequential sector boundary passage (+/-) occurs between April 26 and 27. Geomagnetic storm begins gradually Apr. 27 ^d 15 ^h UT.			

Jul. 19 ^d 05 ^h 03 ^m	E/>30KEV/400	-	□	Jul. 19 ^d 03 ^h 45 04 ^m 20	II(M) II(M)	11976? 00011 2	Regions 11947 and 11957 (which return as active region 11976) are about 4 days beyond west limb.
19 ^d 05 ^h 10 ^m	E/0.5-1.1/3.4						
19 ^d 05 ^h	P/19-80/0.016						
Jul. 22 ^d 04 ^h 02 ^m	E/>30KEV/730	22 ^d -/ 0.5 db	□	Jul. 22 ^d 03 ^h 34	II(M)	11976? 00010 1	The great Aug. region 11976 would be at the C.M. on the Invis. hemis.
22 ^d 05 ^h 30 ^m	E/0.5-1.1/20.0						
22 ^d <12 ^h	P/>60/1.39						
Jul. 23 ^d 00 ^h 23 ^d 04 ^h	E/0.5-1.1/- P/19-80/0.033	-	◇	A long slow continuous increase in electron and proton flux, not flare-associated. Probably related to the coming great August region 11976.			
Aug. 5 ^d 03 ^h	P/>60/-	-	○ or ▲	Aug. 5 ^d 02 ^h 34	sf N14E19	11976 00110 2	Long gradual flux increases lasting >6-10 days. Region 11976 is first seen at east limb on Jul. 28th.
Aug. 16 ^d 02 ^h 05 ^m	E/0.5-1.1/5.2	-	?	Aug. 16 ^d 0140UT - start of an X-ray burst, but no known flare or other events. Active regions 11976 and 11979 are on invisible hemisphere, 4 days and 2 days beyond west limb.			
16 ^d 02 ^h 30 ^m	P/19-80/0.0063			Also sequential sector boundary passage (-/+ between Aug. 16 and 17.			
Aug. 16 ^d 13 ^h 20 ^m	E/>30KEV/700	-	?	Aug. 16 ^d 1227 UT - unclassified dynamic spectrum radio burst(M), + cont(M,DKM), but no known flare. Source possibly is on invisible hemisphere.			
16 ^d 12 ^h 45 ^m	E/0.5-1.1/8.0			McM-H observers report "calm disk" at this time.			
16 ^d 13 ^h	P/19-80/0.032						